

# **EXHIBIT C**

File copy

## D-Limonene As A Degreasing Agent

By  
RICHARD L. COLEMAN  
Citrus and Subtropical Products  
Laboratory\*  
Winter Haven, Florida

### Abstract

The potential of d-limonene (the principal component in orange oil) as a degreasing agent was explored. D-Limonene was used in three formulations: a gel-type hand cleaner, a lotion-type hand cleaner and a gel-type engine cleaner.

### Introduction

Increasing recovery of distilled oils (mostly d-limonene) by the citrus industry has prompted investigations

\*One of the laboratories of the Southern Region, U. S. Department of Agriculture, Agricultural Research Service.

Mention of brand names is for identification only and does not imply endorsement by the U. S. Department of Agriculture.

on potential new uses for this by-product.<sup>1</sup> Since d-limonene is an excellent solvent for grease and other organic materials, its use as a degreasing agent for machinery and as a waterless hand cleaner was explored. The methods and results of this investigation are the subject of this report.

Continued on Page 24



Irrigation and  
Frost Protection

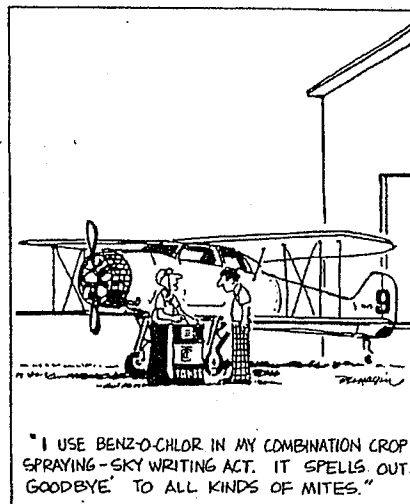
**georges  
enterprises,  
Inc.**

P.O. Box 2771  
523 Recker Hwy  
Winter Haven,  
Florida 33880  
Ph. 813-967-4425

\*Patented

## Goodbye to Mites ...

# BENZ- O- CHLOR<sup>TM</sup> 4-E



**Ask Your  
Chemical  
Supplier**

**BENZ-O-CHLOR 4-E miticide is an emulsifiable solution containing 4 pounds of chlorobenzilate per gallon.**

# T O W E R CHEMICAL COMPANY

Montverde Road and S. C. L. Railroad  
CLERMONT, FLORIDA 32711  
(305) 656-2333

## IRRIGATION...

It's Too CRITICAL  
And Costly Not To  
Contact The BEST

**50 +  
years**

*Irrigation and Pumping  
Specialists*

- CENTER PIVOT
- DRIP
- SOLID SET
- TRAVELING GUN

**FARM & HOME  
MACHINERY CO.**

430 W. ROBINSON ST.  
ORLANDO, FLA. 32802  
(305) 423-4474

Joseph M. McNamara, P. E., President  
Charter Member:  
FLORIDA IRRIGATION SOCIETY



## Degreasing

Continued from Page 23

### Experimental

Distilled citrus oil (~94% d-limonene) was obtained from a chemical supplier<sup>2</sup> and used in the following formulations:

#### Gel-Type hand cleaner

Solution A: 30 g stearic acid  
40 g oleic acid  
100 g Renex 690<sup>3</sup>  
(or 30)

510 g d-limonene

Solution B: 5.0 g sodium hydroxide  
315.0 g water

**Instructions:** Gradually heat solution A until the stearic acid melts, then cool to room temperature. Add solution B to A, mixing well until a gel forms.

#### Lotion-Type hand cleaner

Solution A: 300-450 g d-limonene  
30 g lanolin

Solution B: 25 g Arlacel 40<sup>3</sup>  
75 g Tween 40<sup>3</sup>  
15 g Arlacel 60<sup>3</sup>  
85 g Tween 60<sup>3</sup>

**Instructions:** Mix solutions A and B, then heat to 60°C. Heat 420-570 g of water to 62°C and mix with solution (A + B). Stir moderately until the emulsion is cool.

#### Gel-Type Engine cleaner

500 g d-limonene  
100 g Gafac RM - 510<sup>4</sup>  
370 g water  
30 g triethanolamine

**Instructions:** Boil the mixture.

### RESULTS AND DISCUSSION

The gel and lotion hand cleaners incorporating d-limonene as the main

solvent were prepared and evaluated as waterless hand cleaners. Also, citrus oil and the gel-type engine cleaner with d-limonene as the major component were evaluated as engine cleaners.

In tests conducted by Lehning,<sup>5</sup> he and his mechanics found the formulations containing d-limonene equal to commercial waterless hand cleaners in loosening and removing grease from

their hands. In other tests, they found the citrus oil products to be as effective as commercial cleaners in removing grease, sludges, lacquer-like residues and other deposits that accumulate on and in machinery during use. They expressed a definite preference for the citrus oil-containing engine

Concluded on Page 25



Charter Member Florida Irrigation Society



*B. C. Cook & Sons Enterprises, Inc.*

OVER 40 YEARS SERVICE TO THE CITRUS INDUSTRY

- Citrus Fruit Distributors
- Bulk Concentrate Sales and Processing
- Complete Grove Service
- Chilled Citrus Sections
- Participation Plans
- Cash Fruit Buyers

B. C. Cook & Sons Enterprises, Inc.

413 N. 12th Street  
P. O. Box 1597



Haines City, Florida 33844  
Phone: 813/422-1121

Affiliated with Growers Processing Service  
Highland City, Florida

Ask Your  
Chemical Supplier  
About...



**COP-O-CIDE™**

Florida Made for the Agri-Trade

**TOWER**

CHEMICAL COMPANY



Montverde Rd. and SCL  
CLERMONT, FL. 32711  
(305) 656-2333

## Applicants Wanted For Harvesting Incentive Plans

Specialty or "zipper skin" fruit varieties represent a major harvesting problem for the Florida citrus industry but a new incentive plan being recommended by the Florida citrus harvesting research and development committee may prove that the job can be made easier.

Terms of the plan call for the Florida Citrus Commission to share 50 per cent of the cost of abscission agents or fruit loosening chemicals used on fruit that will be harvested by hand.

Jim Blair, of the Florida Department of Citrus and coordinator of the research and development effort, said harvestors and growers interested in taking advantage of the incentive should contact him immediately for applications.

"Each cooperator can receive up to \$500 toward the costs of chemicals, applied at the manufacturer's recom-

mended rate," Blair said. "We've budgeted \$50,000 for the incentive program."

The committee also approved two other plans for recommendation to the Commission that are designed to encourage mechanical harvesting operations and provide crucial data. A research plan to gain data important to the industry's overall effort was recommended and a budget of

\$30,000 set. Incentive rates under this plan will be determined on an individual cooperator basis.

Blair explained that the entire research and development effort must be based on "reliable data that will reveal a system's efficiency and commercial feasibility."

A mechanical harvesting incentive

Concluded on Page 26

## Degreasing

Continued from Page 24

cleaner because it caused less skin irritation and had a more pleasant odor than the commercially available engine cleaners.

Thus, the d-limonene-containing hand cleaners were as effective as commercially available waterless hand cleaners. As engine cleaners, d-limonene-containing gel and liquid had two advantages over commercial degreasers, a pleasant odor and caused less skin irritation. Further information may be obtained by contacting the U. S. Citrus and subtropical Products Laboratory, P. O. Box 1909, Winter Haven, Florida 33880.

### REFERENCES

1. Coleman, R. L. and P. E. Shaw. 1974. Potential uses of some distilled oils. Citrus Industry 55(2):20.
2. Florida Chemical Co., Inc. Lake Alfred, Florida.
3. Renex 690, Airlacel 40, Tween 40, Aracel 60 and Tween 60 are emulsifying agents purchased from Atlas Chemical Industries, Inc., Wilmington, Delaware. 19899.
4. Gafac RM-510 is an emulsifying agent purchased from General Aniline Film Corp., 140 West 51st, New York, New York 10020.
5. Mr. Lester Lehning, Mechanic-in-Charge, Dorco Inc., Barlow Air Base, Florida, personal communication.

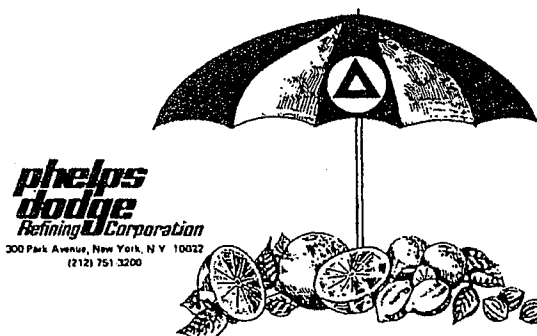
## NOW - for growing PROFIT - look into KIWIFRUIT

This wonderfully delicious fruit offers unusually high profits to the capable grower. For information about top quality plants direct from New Zealand, write to

BRAMEN COMPANY, INC. Dept. CI  
P. O. Box 70 Salem, Mass. 01970

## Protect Citrus from Melanose, Greasy Spot, Brown Rot, and Citrus Scab with

## Basic Copper Sulfate



Also Producers of Pentahydrate Copper Sulfate - Selenium - Copper Oxide  
Be certain that the product you buy is registered with EPA